THE

Indian Tea Association.

SCIENTIFIC DEPARTMENT

QUARTERLY JOURNAL.

PART II.

1923.

Calcutta:
PRINTED AT THE CATHOLIC ORPHAN PRESS
3 & 4, PORTUGUESE CHURCH STREET.

1923.

CONTENTS.

	Page
Observanda	31
Soil survey notes	43
The tocklai pruning experiments	52
A new book on tea diseases	65

OBSERVANDA.

Some two years ago one of the popular illustrated weeklies contained a full-page illustration representing a male mosquito, in dishevelled evening dress and an obvious state of inebriation, maintaining himself with considerable difficulty on a precarious perch at the edge of a rose, while on one of the leaves close by were two female mosquitos, one, with the fore-leg raised like a warning finger, dressed in elderly fashion, the other, wearing an expression of alarm, clothed in a costume designed to suit a damsel of eighteen or so. Beneath the illustration was the caption :—

Miss Mosquito :—"Good gracious, mother ! What on earth is the matter with father ?"

Mrs. Mosquito :—"Hush, darling ! He's bitten a Scotsman."

The inference, though unfair, is obvious, and the humorist illustrated, consciously or unconsciously, a fundamental truth which is becoming increasingly recognised and acted upon by entomologists and others interested in entomological problems, namely, that the well-being of insects is very largely dependent on the nature of the food supply.

Only the other day a medical officer in the tea districts remarked to the writer upon the fact that some persons seem to to be immune from the bite of the domestic mosquito, while others are always bitten, and described experiments he had carried out which proved the preference of the insects for the blood of one person as compared with another. This gentleman suggested that if the blood of such people were to be analysed and the cause of the mosquitos' dislike for certain people ascertained, much could be done to render people immune from attack by inoculation with the proper substance—a method of approaching the medical problem precisely parallel to that outlined in the paper recently published by this Association on "Factors Affecting the "Control of the Tea Mosquito Bug."

Some may wonder whether this method of approaching economic entomological problems has any adherents amongst experts in this branch of science, and might perhaps feel more confidence in accepting recommendations based on the results obtained by this method of approaching the mosquito bug problem if they could feel that the method is looked upon with favour by workers on allied problems in other parts of the world.

That this is so cannot be denied. The unfortunate part of it is, that while many have preached, few have practised. Research along these lines, and indeed along all lines which may be included under "Cultural" methods of control, leads the investigator, sooner or later, beyond the limits of entomology, as strictly defined, and this has proved a stumbling-block which many have found themselves, for various reasons, unable to overcome. So long ago as 1907, H. A. Morgan, in his Presidential address to the Society of Economic Entomologists, put forward a plea for greater attention to cultural methods of control.

Said he :—"The conceptions of the scope of entomological "research as related to agricultural development have gradually but "surely been expanded, until now a worker in this field finds him- "self involved in problems of very much wider range than the "superficial anatomy of a common enemy of a local crop, or the "compounding of a standard insecticide.....the "best methods of control of many of the insect enemies of a "diversified agriculture are to be found in the adjusting of agri- "cultural practice to biologic conditions..... .....Some may "think these matters belong to other departments of agricultural "investigation, and that the recommendations which are the "outcome of biological study should be turned over to other "persons for their execution. Such action is not in keeping "with the crop producer's estimate of agricultural organisation, "and he is an important factor in the successful development of "any remedial plan. Delay consequent on the shifting of the "execution of any method or methods is destructive of the best "interests of agriculture and of the various sciences which make "up its multifarious structure.

"In concluding, I wish to express confidence in the oppor-
"tunities offered to economic entomologists for the development
"of preventive and remedial measures against insect attack, by the
"timely correlation of a thoroughly matured knowledge of agri-
"cultural conditions with an exhaustive life-history and habit
"study."

In the discussion which followed, Mr. J. B. Smith said he believed that "owing to the recent extension of the field of the "economic entomologist that there is danger that he may un-"consciously get out of his proper field of work." Yet, in a paper on "Cultivation and Susceptibility to Insect Attack" read before the same meeting, Mr. Smith said, "It is unscientific to "devote ourselves merely to securing and testing spray mixtures, "however necessary these may be for immediate results, if there "is a possibility of securing exemption by increasing resistance "or by adoption of fertilising methods more in accord with the "real needs of the plants." This is typical of the attitude adopted by many members of the entomological profession, namely, that such methods of control hold out most prospects of success, but that their investigation is hardly within the province of the entomologist, and the result is expressed in a statement made by Mr. J. G. Sanders in his Presidential address to the most recent meeting of the same society, held in December 1922, when he said: "Another great field of much promise is open to us "which in its contacts with allied branches of agriculture and "horticulture has been developed but slightly; *viz.*, crop sanita-"tion and crop rotation problems to be worked out with the soil "expert and the agronomist. Probably herein lies the greatest "opportunity for cheap, valuable, and reasonably constant pest "control without serious interference with customary routine "practice. The writer believes that preventive entomology, akin "to preventive medicine, has an interesting development just "ahead."

Many similar quotations could be culled from past and present entomological literature, and W. F. Fiske, in the Bulletin of Entomological Research, Vol. VII, 1916, makes the bold statement

"that one race or species of organism is injurious or beneficial in "its relations to another species, not in accordance with the "characteristics, habit and instincts of the individuals involved, "but in accordance with the circumstances and conditions pre- "vailing at the time and place which brings them into contact. "These circumstances and conditions are continually changing "with respect to both time and locality."

Accounts of investigations into this branch of the study of control are by no means so common as expressions of opinion as to its value, but some few cases have come within the writer's experience, and some account of what has been, and is being, done in these cases may be of value in showing that observations in other parts of the world have led certain workers to similar conclusions, and that laboratory work is proving that the well-being of the insect can be controlled, to a great extent, by altering the condition of the plant.

In 1914 or 1915 H. A. Ballou,* Entomologist to the Imperial Department of Agriculture, British West Indies, devoted considerable study to the subject of control of the Cacao Thrips in Grenada, and the following extracts from his report will be of considerable interest to all who have read "Factors Affecting the "Control of the Tea Mosquito Bug."

"This insect has been known in Grenada since 1898, and "has been considered a pest of cacao by planters and others. At "the present time thrips probably occurs in all parts of the island "I visited, and I think I might say in every field. It was, "however, only in certain fields, and often in small areas in those "fields, that planters considered that damage had resulted. The "remarkable thing about the occurrence of thrips is that it "appears year after year on the same areas, even on the same "trees, though sometimes spreading a little ; but a thrips area one "year is liable, or certain, to be a thrips area every year."

"I discovered a remarkable unanimity of opinion among "Grenada cacao-planters in regard to the occurrence of thrips

* "Observations on Insect Pests in Grenada. The Cacao Thrips (*Heliothrips rubrocinctus*, Giard)." See the Bulletin of Entomological Reserch, VI, 1915, p. 173.

"during this last visit. In every instance where I was shown "thrips attacks, or the effect of thrips, I was told that 'this piece "'gets it every year,' but in every instance something besides "thrips could be shown to be wrong with the trees. Before "considering what these other factors are, I would draw attention "to four points with regard to the cacao thrips in Grenada :— "(*a*) Thrips are present throughout the island, and at certain "times it is doubtful if, on those estates, where outbreak of thrips "occur, there are any trees which are entirely free from this insect ; "(*b*) thrips in the adult stage are capable of flight and the active "young might readily be carried from tree to tree by birds and "large insects ; (*c*) thrips attacks occur on the same limited areas "year after year ; (*d*) thrips is a dry-weather and a dry-locality "insect as a general thing, and yet in Grenada it generally becomes "most troublesome towards the end of the wet season.

"In the case of an insect which is at all times well distributed "throughout the island, and which can migrate and can easily "be transported, it is remarkable that their attacks should always "occur on limited areas and on the same areas year after year, "and that these attacks should occur in the wet season, which "would be expected to be the time when the plants would do "their best and thrips would be reduced in numbers. It seems "to be generally accepted that this species may be present year "after year in cacao and never increase in numbers sufficiently "to attract attention or to cause any injury."

Mr. Ballou concludes his report with the remark :—"The "effective control of thrips will only be secured by the eradication "of root disease, better drainage and better soil conditions "generally."

In 1916 C. B. Williams, Sugar-cane Entomologist to the Department of Agriculture, Trinidad and Tobago, commenced observations on the froghopper pest* (or froghopper blight, as he

* *Tomaspis saccharina* (*Hemiptera, Cercopidae*).

A sucking bug belonging to the same order of insects as *Helopeltis*, but more closely allied to our tea greenfly (*Empoasca*).

calls it) of sugar-cane, which culminated in a comprehensive report published in 1921. One section of this report is devoted to "The Factors Influencing the Prevalence of Blight." Here Mr. Williams says :—

"These factors may be conveniently grouped under four "sub-headings :—

"(1) The physical environment, or those factors such as "rainfall, temperature, soil, and contours of the land, over which "man has little or no control.

"(2) The agricultural processes ; such as drainage, tillage, "rotation, manuring, etc., by utilising which the planter can make "the best of his given physical environment."

"(3) The characteristics of the cane itself, which vary in "different varieties and produce greater or lesser resistance to injury."

"(4) The direct effect of the numbers of froghoppers "present and the effects of root fungus and other diseases on the "cane in weakening resistance to further attacks or preventing the "recovery from past injury."

The various factors are then discussed at length.

The first factor discussed is rainfall, and in this connection Mr. Williams says, "the quantity and distribution of the rainfall "during the year is probably the most important single factor in "the environment of the froghopper," and finds "that there is no "relation between the total annual rainfall and blight, but that "there is evidence that the distribution of the rainfall has a distinct "effect." Mr. Williams publishes curves, based on the rainfall figures, to prove his point, and concludes that an exceptionally wet period in June and July, followed by an exceptional drought in the so-called "Indian Summer" in September or October, tends to increase the apparent damage by froghopper. Interested readers may remember that in Part IV of the Quarterly Journal of this Department for 1919,† the writer described how the ultimate effect of waterlogging and extreme drought on the physiology of a plant

† p. 121—in an article, entitled "A Preliminary Note on the Present State of the "Mosquito-Blight Enquiry."

might be the same. The interesting feature of Mr. Williams' observations, so far as tea is concerned, is the fact that, as we have found in the case of the Tea Mosquito Bug, the important factor is not the amount of rain which falls during the year, but the manner of its distribution, and in Trinidad Mr. Williams reports that in districts where the rainfall is most regularly distributed, sugar-cane froghopper does least damage.

Mr. Williams then goes on to consider the soil factor, and opens with the remark that "In the flat parts of the Northern "and Central sugar districts the soil is usually more or less "uniform over large areas, and one finds also that the blight is "often uniformly spread over whole fields or even larger areas if "otherwise similar. In the Naparimas, on the other hand, the "soil is more irregular and the blight more patchy. It was "noticed many years ago that injury was always more severe on "the red soils than on the black. Sometimes a red-soil field is "badly damaged alongside a black-soil field which is untouched. "At other times part of a field is damaged, and this is found to "be a different and poorer type of soil." Instances are cited of occurrences of this nature, and the following very interesting remark is added :—

"In 1919 a number of damaged fields on Hermitage and "Golconda estates were observed to be roughly in a straight line "running East and West. This is the direction of the geological "strike in this district and when the positions were shown to a "local geologist he stated that the damaged fields corresponded "very closely with the outcrop of a certain type of clay as indi-"cated by his geological maps."

Samples of soil from damaged and undamaged areas were analysed, and those from the latter areas appeared to be, on the whole, richer in nitrogen and lime than the others, while the soil on which the cane showed least damage of all was the only one that gave an alkaline reaction, the rest being neutral or acid. Soil constituents other than those referred to above showed no significant differences, but "available" quantities do not appear to have been estimated.

The discussion on soils concludes with the following summary :—

"It will be seen that there is a distinct evidence that the "froghopper breeds with greater freedom and that the blight is "worse on heavy, sour soils than on light, well-aerated, well-"limed soils.

"Sometimes a soil that is chemically suitable gets into a bad "condition, owing to lack of cultivation. On one estate with a light "soil the froghopper attack in 1919 was confined to an area where "the soil was compact and very badly in need of cultivation.

"Soils in such a condition are not suitable for the growth "of the soil bacteria which cause decay, and until they are properly "turned over and cultivated, cane trash or even pen manure may "be seen in compact masses in the ground, not decaying to form "the humus that is so essential for the improvement of the soil "and the supply of organic plant food.

"It is not only in Trinidad that the close relation between "soil conditions and froghopper blight has been noticed.

"In his report on the Blight in Mexico, Urich (Bull., Dept. "Agr., XI., No. 71, p. 298), says, 'On the plantation where I "'was the froghoppers occurred under exactly the same conditions "'as here (Trinidad), *viz* :—on low-lying damp ground they were "'numerous on cane and grass, becoming less on porous and "'friable soils.'"

"In the outbreak in British Guiana in 1918 both Bodkin "and Moore emphasised the importance of soil conditions. Bodkin "(1918 B.) mentioned the waterlogged condition of the soil "aggravated by the injurious effect of the use of nitrate of soda, "and Moore (1919) says when the soil was stiff the insects tended "to be more numerous. 'At Plantation Ogle.....the canes "'showed distinct evidence that they had been contending against "'an excessively moist, cold, stiff clay, and it was these soil "'conditions which primarily induced the froghopper attack.'"

The drainage factor is next considered, and one instance is quoted in which an attempt was made to test it.

"In one field in the Naparimas, where froghoppers had "been persistent for many years, the beds and the sides of the "drains on part of it were forked in September 1918 to allow the "moisture to percolate better into the drains. In the following "year the froghoppers and consequent blight were much less "serious on the part that had been forked than on the unforked "part. This case is confused by the effect that the forking would "have on the aeration of the soil, but there is little doubt that "both contributed to the final beneficial result.

In connection with manuring, Mr. Williams says:

"Continual application of artificial manures must be counter-"acted by application of lime. This is already done by many "estates, but seldom to the necessary extent. The analyses given "above for damaged and undamaged soils show the importance "of soil acidity in connection with blight, and heavy applications "of lime are necessary to eliminate this.

"The effect of such applications to lands subject to blight "must not be expected immediately, nor will they be for ever "after free from injury, but with proper agriculture there should "be a gradual return to soil conditions under which damage is "less likely to occur."

On top of all this he finds that "owing to the varying con-"dition of the resistance of the cane the same number of frog-"hoppers do not always cause the same amount of damage. Thus "fields are found severely damaged by infestation of froghoppers "that would in other fields have caused a much less serious injury."

First amongst the preventive methods proposed, Mr. Williams places attention to drainage, care in the selection of manures, and careful cultivation.

So much for such field work along these lines as has come within the purview of the writer. In the meantime, investigations are being carried on by certain workers, in the laboratory, on the minutiæ of these interactions between the plant and the insect, which are giving exceedingly interesting and important results. It is not possible, unfortunately, to say much about this work.

It is still proceeding, and the results have not yet been published, and the writer is indebted to the courtesy of the gentlemen concerned in permitting him, when home on leave, to see what was going on. Dr. Davidson, Entomologist at Rothamsted Experimental Station, has been experimenting with certain species of Aphis, which he has reared in the laboratory, on the same plant grown in culture solutions of varying composition. He finds that, in some cases, the insects thrive and show an enormous fecundity, while in others they become sterile by the third generation—a result both startling and hopeful. Another piece of work the writer was privileged to see was being carried out by Professor Lefroy's assistant, who was working on the inter-relationships between scale insects and resistant and nonresistant varieties of plant. In this case the problem was of a different nature, but is worthy of mention here as it indicates that the difficulties the insect encounters in obtaining an adequate supply of food may, on occasion, be due to mechanical as well as chemical causes. Take a cork and a strong household pin. This pin may be held by the head and pushed through the cork, and the point will travel along a straight line, and, if the pin has been held perpendicular to the surface of the cork, will emerge from the other side directly opposite the head, and the pin will lie along the straight line traversed by the point. Substitute, however, a very thin flexible pin. This cannot be held by the head and inserted. It must be grasped close to the point and pushed a little way in, then gripped a tiny bit further back, and pushed in a little way more, and so on. The point may emerge at any place, and at any angle, for it will follow the path of least resistance, and not go straight through. Now scale insects have an enormously long and very slender proboscis, and it has often been a matter of wonder to thoughtful people that they were able to pierce such hard substances as, for example, the bark of trees. The illustration of the slender pin affords a possible explanation of the manner in which a scale insect inserts its proboscis. Having inserted part of it, however, it has no control over the path traversed by that part, which follows the line of least resistance, just as the slender pin does in going through the cork. Should the cell walls of the

plant be soft enough to offer little resistance to the passage of this slender instrument, all is well, but should they be hard enough to resist its passage, the proboscis is deflected, and follows a course through the air spaces between the cells, and the insect is, of course, unable to obtain nourishment. Professor Lefroy's assistant had some very interesting preparations, showing that this was actually what was happening in the case of the particular resistant variety of plant he was dealing with.

Thus, while in many cases the chemical composition of the sap of the plant puts difficulties in the way of the insect, and prevents it from obtaining a sufficiency of nutritive food, in other cases mechanical causes intervene.

Whether the obstruction to nutrition be caused by chemical or mechanical phenomena, the result is the same—the food supply of the insect is interfered with and the insect suffers in consequence.

Napoleon's *obiter dictum*, that an army marches on its stomach, applies with equal force to insect armies.

Nothing could be more encouraging, from the point of view of control of the Tea Mosquito Bug, than the results which have been outlined above. The idea that research along such lines might give valuable results is by no means new, as the quotations at the beginning of this article show, but very few workers have gone into the matter thoroughly. The results of those who have, as will be seen from what has been cited above, all point the same way, and this in spite of the fact that these investigators have been working in different parts of the world, and unknown to each other. Much remains to be done. New theories, even when proven, cannot often be adapted to the requirements of practice until after much patient research. To cite but one instance, the possibility of the propagation of electric waves through space without the use of wires was known for years before the Marconi system of wireless telegraphy was devised. Still, the thin end of the wedge has now been inserted. The science of insect control is at last developing along logical lines and on a scientific basis,

and the shortcomings of the illogical and haphazard methods which have been practised in the past are being increasingly recognised. Those methods will die hard. Manufacturers of insecticides and such-like will not watch their profits diminish without making some effort to counteract these opinions, and it must be remembered that while the investigators are working, quietly and unostentatiously, in remote corners of the globe, those interested in keeping the older methods to the fore will be advertising their wares and attracting the attention of "the man-in-the-street."

E. A. A.

SOIL SURVEY NOTES

BY

H. R. Cooper, B.Sc., F.C.S., and C. R. Harler, B.Sc., A.I.C.

THE DARRANG DISTRICT.

PART III—The Orang District.

This district may be considered to extend from the Dhansiri to the Gabharu River, which is close to the Tezpur Red Bank.

The district has not been visited by any of the officers of the Association, but many gardens have lately been opened out and several soils from these and older gardens have been analysed.

These notes being in the nature of an interim report, it is desired to set down as much information as we have, even though it be not of a personal nature.

The district is reported to be generally flat, sandy land, mainly under high grass.

Its flatness is seen from the map. For example, from Jikribari to the Brahmaputra bank due south near Singri, the fall is only about 100 feet in a distance of about 15 miles.

Rota, on the west bank of the present course of the Dhansiri, shows the following soil types :—

2, 3, 4, 5, 1 (2 examples.)
2, 3, 4, 1, 5.
4, 3, 2, 5, 1.

These types are common among the Mangaldai soils, which they resemble very closely.

East of the present course of the Dhansiri the gardens of the Orang district, which have been analysed, show very marked differences from the Mangaldai soils.

The following types have been found :—

Majbat—	2, 1, 4, 3, 5.	
	2, 1, 4, 5, 3	(2 examples.)
	2, 1, 5, 4, 3.	
Bateli—	1, 2, 4, 5, 3.	
	1, 4, 2, 5, 3.	
Bettybarie—	1, 2, 3, 4, 5.	
	1, 2, 4, 3, 5.	
	2, 1, 4, 3, 5	(2 examples.)
	2, 4, 3, 1, 5.	
	4, 2, 1, 3, 5.	
Singri—	1, 2, 4, 3, 5.	
	2, 1, 4, 3, 5	(2 examples.)
	2, 4, 3, 1, 5.	
Chardwar—	2, 3, 4, 1, 5.	
	2, 3, 4, 5, 1.	
	5, 2, 4, 3, 1.	

Mangaldai "silt-loam" types are found at :—

Bettybarie—	2, 4, 3, 1, 5.
Singri—	2, 4, 3, 1, 5.
Chardwar—	2, 3, 4, 1, 5.

One example of a heavy soil, of 5, 2, 4, 3, 1 type, comes from Chardwar.

Otherwise the soils are very distinctly sandy, the 2, 1, 4 type predominating, while the closely related 1, 2, 4 type is also common.

The characteristic soil of the district may therefore be considered to be of the 2, 1, 4 type. The analyses of the seven examples of this type give averages as below :—

Mechanical Analysis.

Coarse sand	26
Fine sand	43
Silt	9
Fine silt	14
Clay	5
Loss on ignition	3·1

Chemical Analysis.

Grandeau organic matter ...	1·6
Insoluble silicious matter ...	91
Acidity (Veitch-Albert)	1270
Total nitrogen	·08
„ phosphoric acid	·04
Available phosphoric acid ...	·008
„ potash	·016
„ lime	·02
„ magnesia	·04

For a light soil this average soil is quite a good one, with no marked deficiencies.

Individual soils of course show figures much below these averages in one or more particular respects, in which case the soils are in need of treatment. From the variation in physical type occurring on the same garden the soils are obviously patchy.

Although there is not yet a reported case of an alkaline soil, there are cases of very low acidity and high lime, and it is probable that cases of alkaline soils will be found.

Some few patches of extremely sandy soil occur on which the establishment of tea may be a matter of difficulty. One of these contains 60% coarse sand, and 30% fine sand, with only 1% clay. Unlike similar very coarse soils in the Dooars, it is not high in organic matter. One would expect tea to be successful on such a soil only if it is fortunately situated with regard to subsoil and water-table.

All these sandy types of soil are those which we associate with deposits from the Brahmaputra. The Brahmaputra has here clearly been working south, as shown by old banks north of its present bed.

The Dhansiri, which used to run fairly consistently north to south, has now taken a turn to the south-east, which may indicate that the land to the west has risen relatively to the Orang district. The old course of the Dhansiri is marked on the accompanying sketch map of East Mangaldai as the "mora" or "dead" Dhansiri.

PART IV—The Tezpur District.

The gardens of the old Tezpur tea district lie mainly between the Gabharu and Borelli Rivers, which latter divides Tezpur from Bishnath. The feature of this district is the Tezpur bank.

Along the road or railway from Tezpur to Kotalguri, red soil crops out in one or two places, and it is probable that "Red Bank" soil forms the subsoil, at a greater or less depth, of the gardens between the river and the bank. This subsoil has been overlaid by later deposits of very variable composition, some being distinctly reddish and apparently mixed with soil from the bank.

As one proceeds up the bed of the Diputa there are gentle rises on each side to the red bank soils of Rupajuli on the west, and Sessa on the east. The bank extends on each side of the Diputa bed to the extreme north of the district.

To the north it ends abruptly in places, as where it drops abruptly into a bheel at Kolony, and into a hullah at Kacharigaon. On another part of Kolony it merges imperceptibly into a darker loam, while a similar change takes place between Dhendai and Tarajuli, the average soil of which latter garden is a dark sand except for a tongue of red-bank soil running through it and appearing again farther north.

On the west the Borjuli River practically forms the boundary.

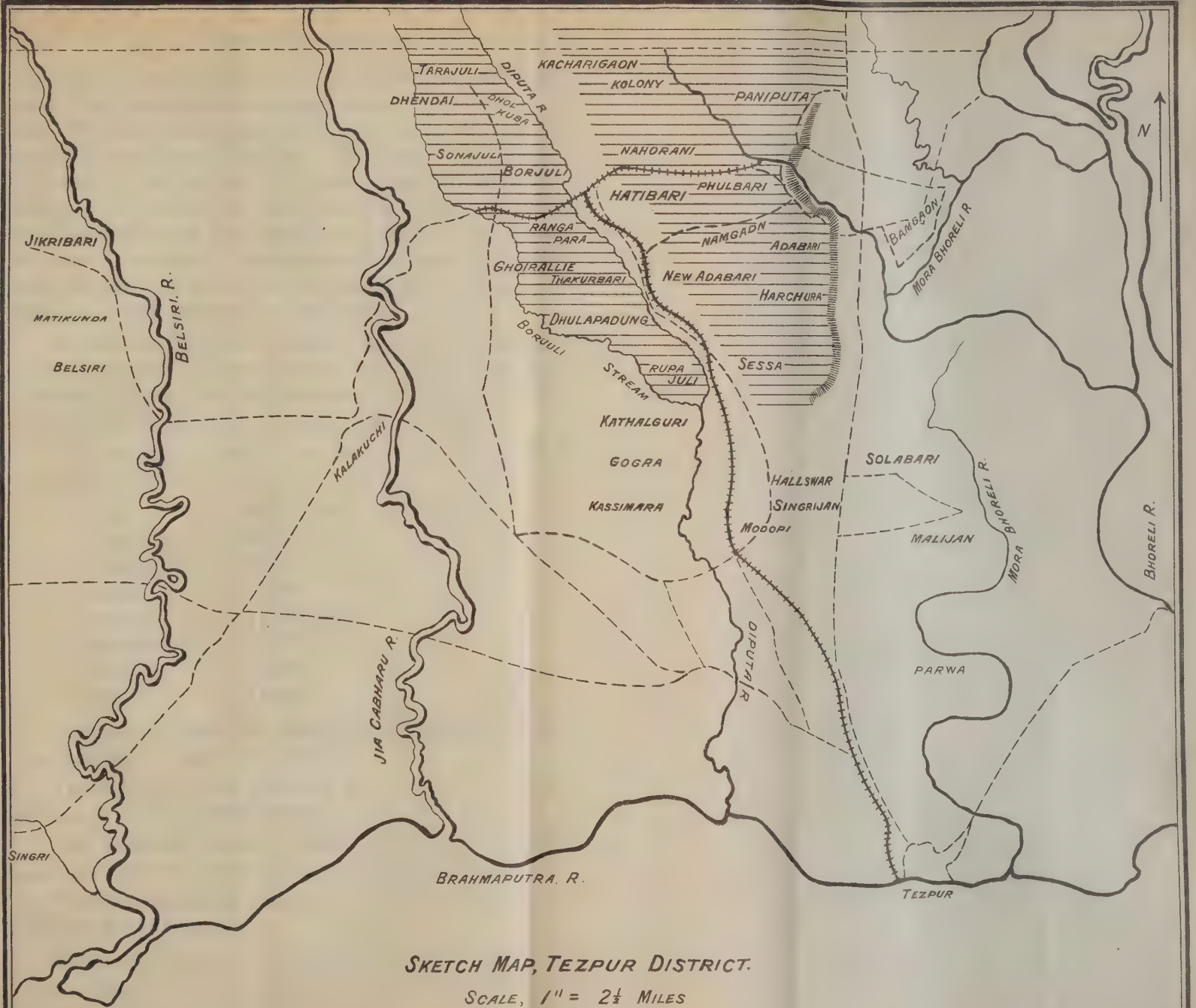
To the east the bank ends abruptly at Paniputa, Phulbari, Addabari, and Harchura, with a sheer drop of 20 to 30 feet to to the rice land level.

On the accompanying sketch map the red-bank area has been indicated by shading.

The soil of the Tezpore bank appears to be very variable.

The bright, deep-red soils, such as occur on the higher undulating land at Borjuli, have the appearance of sandy loams with significant percentages of clay.

On many of the slopes, as at Rangapara and Thakurbari, often of a more yellow-red colour, there are quite coarse sands. On the



SKETCH MAP, TEZPUR DISTRICT.

SCALE, 1" = 2½ MILES

NAMES OF TEA GARDENS AND RIVERS ONLY GIVEN.

ROADS _____

RIVERS ~~~~

TEZPUR BALIPARA RAILWAY

ABRUPT DROP FROM EDGE OF RED BANK

RED BANK AREA SHADED.

BENGAL ART STUDIO & PRINTING LTD

east bank of the Diputa, as on parts of Namgaon and Phulbari, the soil only becomes red on thorough aeration and drainage, and such differences in soils appear from place to place that the soils might be described as "pockety." Patches of white silt appear in places as at New Addabari. The more recently planted red-bank soils are rich enough in organic matter to mask the red colour, and it is probable that the appearance of bright-red colour may be taken as evidence of deterioration from years of cultivation often accentuated by wash. The soil and subsoil, however, are so good that even the oldest tea may still do well.

Of the analyses given below, it is not even certain that all are from actual red-bank soils. Some may be from patches of more recent deposit; but from inspection it is certain that soils of widely-differing physical type occur on the bank itself.

The following physical types occur among the soils of the red-bank gardens :—

Sessa	... 23451, 23415, 32451, 25431
Thakurbari	... 21534
Rangapara	... 21354
Borjuli	... 12345
Rupajuli	... 21435, 23415
Dhullapadung	... 21345
Ghoirallie	... 23451
Dhendai	... 13245

Only one of these, the 25431 type containing 20% clay, from Sessa, can be considered a heavy soil.

The analyses of Sessa, averaging about 10% clay, probably represent the average of that garden.

The Thakurbari sample, containing 15% clay, truly represents a real "red bank," although sandy section of that garden.

The Ghoirallie sample, containing 14% clay, is from the red bank area of that garden.

The remaining soils are all very sandy, with little clay.

In physical type, then, the Tezpur red soil differs from the generally heavy red bank of the Dooars. Even on the Dooars

red-bank, however, there are sands, as at Matelli, Moortee, and higher parts of Chalounie, which give no indication of any different origin to that of the surrounding heavy soils.

At Tezpur there appears to be no striking difference in physical type between the soils of the red bank and the newer alluvium surrounding it.

We have not enough analyses of the Tezpur red-bank to be able to see any system in the variation which occurs in the soil. Samples are therefore being collected, and it is hoped that a further note may be published shortly.

Of the soils between the red-bank and the Brahmaputra, we possess only the following analyses :—

New Gogra.—2,1,3,4,5,
a deep sand overlying a subsoil of similar composition.

Old Gogra.—2,3,4,5,1,
physically a good "silt-loam" type, chemically poor and overlying a heavier soil of red-bank character.

Hallswar.—3,2,4,5,1,
physically a good "silt-loam" type, overlying a physically very similar soil. The top soil, however, has a negligible acidity and very high lime, and therefore probably represents a comparatively new deposit.

Kassomari.—1,3,2,5,4,
a good sandy loam of reddish colour, probably mixed with washings from the red bank. It overlies a still heavier subsoil.

Of the soil to the east of the red bank, we have the following examples :—

Bamgaon.—4,2,3,5,1
2,4,3,5,1 (3 examples.)
2,4,3,1,5 (2 „)
2,3,4,5,1

All these are closely-related, "silt-loam" types, physically excellently suited for tea.

The last and lightest of these examples is of low acidity and very high lime, and is therefore probably of recent deposit. Its very high phosphoric acid and low organic matter are features frequently associated with new deposits.

The remainder are chemically very much richer than the average of the district, and were probably deposited from the Bhoreli river when in its old course, represented on the accompanying sketch map by the "mora" or "dead" Bhoreli.

These should be excellent tea soils. They are, however, situated very close to the water table, and, in consequence, require good drainage.

Bhuragaon, of which no analyses are available, appears to be similar.

The grass land south of Bamgaon is represented by five samples from the lands of Sonabheel Tea Company.

At Solabari occur examples of heavy loam, and sandy silt of the 4,2,5,3,1 and 4,1,2,5,3 types, respectively. These are of high acidity, and rich in every respect. They represent old soils.

There is also a very sandy soil of the 1,2,4,3,5 type. This is of low acidity, but not very high in lime, and it is rich in organic matter. This appears to be of intermediate age and should be a fine soil.

From Malijan we have two examples of sandy silts of the 2,4,1,5,3 and 2,1,4,3,5 types. These are characterised by high lime and low acidity, and are probably soils of comparatively recent origin. They do not, however, exhibit the extreme deficiency in organic matter associated with very recent deposits, and the difficulty in growing tea experienced on such deposits is not likely to be seriously felt here.

The analyses given are believed to be fairly representative of the red-bank and the newer alluvium respectively.

It will be noticed that the soils of the newer alluvium are generally richer than those of the red-bank. In that case the general preference for red-bank soils may be considered remarkable. The red-bank, however, enjoys two advantages. Natural drainage is good, and where that requires assistance, it is easily provided. The red-bank soils also are good to a great depth, whereas the grass land of the newer alluvium of the flat land is usually only rich to a small depth.

At the same time the importance of the fact that the red-bank soils are not always rich should be borne in mind. As Mann pointed out, not only do these soils require manuring, but their physical state is such that they will give good returns for money spent in that direction.

SKETCH MAP
OF THE
EAST MANGALDAI TEA DISTRICT.

LIBRARY

EXAMPLES OF SOILS FROM THE TEZPUR DISTRICT.

	Red Bank Soils.			Newer Alluvium.				
	Sessa, New Clearance.	Ghoirallie, Seedbari.	Thakurbari, Old tea, Soil in good condition.	Kassomari, Red loam.	Average Sandy loam.	Bamgaon, New deposit.	Solabari, Rich Sand.	Malijan, Silty Sand.
Soil type.	2,3.4,5,1.	3,2,4,5,1.	2,1,5,3,4.	1,3,2,5,4.	2,4.3,1,5.	2,3,4,5,1.	1,2,4,3,5.	2,1,4,3,5.
MECHANICAL ANALYSES.								
Soluble in dilute acid	0·3	0·8	0·1	0·2	1·2	1·0	1·6	0·8
1. Coarse sand	13	4	21	26	14	2	39	20
2. Fine sand	23	26	32	22	40	58	29	29
3. Silt	23	19	15	23	14	19	9	16
4. Fine silt	19	32	12	9	14	12	12	19
5. Clay	15	13	15	14	12	5	31	10
Loss on ignition (organic matter)	4·5	4·3	3·6	5·2	5·4	3·5	6·6	4·9
CHEMICAL ANALYSES.								
Grandeau organic matter (soluble humus)	2·4	0·9	1·1	2·0	2·1	0·7	2·8	1·1
Insoluble silicious matter	.....	86	87	87	85	86	85	83
Acidity (Veitch-Albert)	2462	1799	1001	1610	2553	676	517	698
Nitrogen	·089	·096	·085	·096	·152	·123	·166	·135
Total phosphoric acid	·046	·039	·035	·020	·14	·25	·061	·129
Available phosphoric acid	·003	·005	·006	·005	·020	·068	·037	·031
,, potash	·007	·016	·019	·012	·010	·020	·020	·014
,, lime	·053	·022	·023	·025	·034	·256	·052	·145
,, magnesia	·021	·037	·019	·037	·011	·079	·022	·096

THE TOCKLAI PRUNING EXPERIMENTS.

(Notes:—Two previous reports on this experiment have appeared under the heading "Pruning Experiments on Young Tea," in the Quarterly Journals for 1918, p. 129, and for 1920, p. 44, respectively.

Other "Pruning Experiments on Young Tea" having now been started, the title of this article has been altered as above.)

This experiment has now been in progress for over five years, during which period much valuable information has been obtained, as regards the effects of the various methods of pruning adopted, both on the bushes themselves and on the quantity and quality of the crop given by them.

The bushes on which these trials are being carried out are now (1923) in their tenth year from seed, having been transplanted from the nurseries in the cold weather of 1915-16, at an average age of rather over two years.

While it is as yet early to draw any very definite conclusions from them, the results so far obtained nevertheless clearly indicate several of the advantages and disadvantages of the system under trial, and at the same time disclose a number of points of minor interest.

The following table gives a complete summary of these results up-to-date, together with the details of the pruning for each year of the experiment.

TABLE I.

PRUNING EXPERIMENT (TOCKLAI).

1913 *Seed.* 1914 *Nursery.* *Transplanted. Autumn* 1916.

1917 Original Pruning.	1918.		1919.		1920.		1921.		1922.		TOTAL.	
	Yield.	Pruning.	Yield.	Pruning.	Yield.	Pruning.	Yield.	Pruning.	Yield.	Pruning.		
Cut at 18″	9·54	4″	9·57	2″	10·26	2″	9·80	2″	10·87	2″	50·04	Assam.
	8·57	4″	8·42	2″	9·79	2″	7·97	2″	9·34	2″	44·09	China.
	8·27	4″	9·50	2″	10·73	2″	11·65	2″	10·60	2″	50·75	Burma.
Cut at 12″	6·87	4″	8·67	2″	10·34	Medium-pruned & centred.	7·68	4″	10·03	2″	43·59	Assam.
	7·93	4″	7·83	2″	9·68		6·02	4″	7·68	2″	39·14	China.
	5·61	4″	8·51	2″	10·82		7·66	4″	10·05	2″	42·65	Burma.
Cut at 6″	4·86	6″	7·81	4″	10·78	4″	8·50	2″	12·41	2″	44·36	Burma.
Cut at 4″	4·76	6″	5·62	4″	7·29	4″	7·44	2″	10·68	2″	35·79	Assam.
	4·36	6″	5·71	4″	5·50	4″	8·39	2″	10·36	2″	34·32	Burma.
Cut at lowest branch.	4·52	6″	5·17	4″	6·17	4″	7·37	2″	10·44	2″	33·67	Assam.
	4·56	6″	5·14	4″	5·44	4″	7·50	2″	10·64	2″	33·28	Burma.
Cut to 2″	4·15	6″	4·76	4″	6·50	4″	6·42	2″	10·68	2″	32·51	Assam.
	5·37	6″	4·79	4″	5·44	4″	4·86	2″	5·93	2″	26·39	China.
	5·17	6″	5·02	4″	6·16	4″	6·68	2″	10·00	2″	33·03	Burma.
A Collar-pruned and then pruned annually.	2·31	6″	4·26	4″	5·23	4″	5·99	2″	10·26	2″	28·05	Assam.
	2·48*	6″	2·75*	4″	3·37*	4″	3·43*	2″	4·49*	2″	16·52	China.*
	2·62	6″	5·22	4″	5·74	4″	8·37	2″	8·72	2″	30·67	Burma.
B Collar pruned and then pruned every 2nd year only.	2·63*	†	4·18*	6″‡	2·80*	†	5·56§*	4″‡	3·30*	†	18·57	Assam.*
	2·55	†	10·23	6″‡	4·71	†	8·63§	4″‡	4·19	†	30·31	China.
	2·13*	†	6·07*	6″‡	4·16*	†	9·25§*	4″‡	6·22*	†	27·83	Burma.*
Cut at 24* collar-pruned in 1920.	8·23	4″	12·17	2″	11·34	C. P.	2·21	Skiffed at 24″	9·27	6″‡	43·22	Assam.
	8·44	4″	12·54	2″	11·48	C. P.	5·26‖		11·85	6″‡	49·57	Burma.

NOTE.—All pruning is given above in "inches of new wood left."

* Drainside lines.
† Unpruned.
‡ On two-year wood.
‡ And "cleaned out."
‖ Kickers left in this case when collar-pruned.

In considering these results, it must be remembered that seasonal variation is a factor of considerable importance and one which not infrequently exercises a controlling influence on crop. It is important therefore that due attention should be paid to it in interpreting the above figures.

1918 was a very fair year for tea, as regards climate.

In 1919 the season was a bad one for leaf in the earlier months, and although most of the lines showed a moderate increase in yield in spite of these adverse conditions, the general condition of the bushes was somewhat weakened, and a heavy dressing of cattle manure was therefore applied after pruning in the cold weather of 1919-20.

As will be seen from the table, this had a decidedly stimulating effect on the crops for 1920 (already a favourable year for leaf-production), particularly in the case of most of the higher-pruned lines, where the root development of the bushes had already become large enough to enable them to obtain full value from the manure. The lines originally pruned at 6, 12, and 18 inches consequently show a somewhat abnormal rise for that year, while it is possible that but for the manure the 24″ lines would have shown a much larger decrease.

The leaf season in 1921 closed suddenly and very early and was consequently poor from the point of view of yielding capacity. Nevertheless fair increases were again recorded for nearly all lines where they could reasonably be expected.

There were practically no early rains in 1922, which made it a very bad season for unpruned tea, but although a fairly early close was generally experienced in this district, the Tocklai records show that yields were well sustained up to the end of November, and were particularly good through October, with the result that all the pruned and even the skiffed lines show very large rises in crop.

Turning now to the consideration of the effects of the various methods of pruning on the yielding capacity of the bushes it will at once be noticed that, with the exception of the biennial pruning

and the lines originally pruned at 24″, and subsequently collar-pruned in the cold weather of 1920-21, which are naturally not analogous, the yields have, to a very large extent, maintained the order of the varying heights from the collar at which the bushes were first pruned.

Thus the lines originally pruned at 18″ have, up to the present, given considerably the largest, and the collar-pruned lines the smallest, total yields in every instance : while, even on the yields for any single season, the 6″ pruned line of Burma for 1922 constitutes the only notable exception.

In comparing these two types of pruning, however, it is significant that for the Assam and Burma lines, whereas in 1918 collar-pruning gave only 28% of the yield from the 18″ pruning, the actual difference in the mean yields from these two jats being as much as 6·44 maunds of pucca tea per acre, by 1922 the yield of the former had risen to just over 88% of the latter, with a difference of only 1·25 maunds per acre. The collar-pruned China line, being one of those which has suffered badly owing to the proximity of a drain, is not comparable.

At the same time it is satisfactory to see that such a high initial cut as 18″ has, after only four years, produced bushes on the Burma plot capable of yielding nearly 12 maunds per acre, in spite of a very indifferent season, but for which the other varieties would presumably not have shown any falling off for 1921, as is evidenced by yields for 1922.

The slight decrease in the mean yield of the 18″ pruned lines in the fourth year is almost entirely due to the reduced crop from the China jat, which is apparently not well suited to long-continued top-pruning, as, when so treated, it tends to run to seed. It must also be remembered that China bushes are less vigorous growers and their sides, therefore, become weakened more rapidly by this method of pruning, and so are more liable to fall an easy prey to disease.

A comparison of the average dimensions of the bushes in the various lines, taken in the middle of the plucking season 1922,

is tabulated below and shows considerable variation in the relative development of the bushes. The bushes are square planted, 5 ft. × 5 ft. apart.

TABLE II.

Pruning.		Height of bushes from ground. (Plucking level.) (1922)	Average diameter measurements at plucking level.			
Original.	Subsequent.		Assam	Burma	China	Mean
Collar Pruned { Annual	6 inches new wood 1st year then 4 inches or 2 inches yearly.	27″	3′ 3″	3′ 9½″	3′ 7″†	3·6½
Collar Pruned { Biennial		,,	3′ 3″†	2′ 11″†	3′ 1″	3·1
2″ above collar, Annual		,,	3′ 9½″	4″ 2½″	3′ 7″	3·10
Lowest branch ,,		,,	3′ 7″	4′ 6″	.....	4·0½
4″ above collar ,,		,,	3′ 8″	5′ 7″	.....	4·7½
6″ ,, ,, ,,		28″	.....	5′ 0½″	.....	5·0½
12″ Annual	Light except 1920 when Medium & Centred.	27″	3′ 8″	5′ 7″	4′ 3″	4·6
18″ ,, ,, ,,	Top, except as under.*	34″	5′ 8½″	6′ 3½″	5′ 2″	5·9
24″* ,, ,, ,,		30″	3′ 2½″	4′ 11″	.....	4·1

* NOTE :—Collar-pruned cold weather 1920-21, skiffed at 24″ 1921-22.

† Drainside lines.

All the bushes in every 18″-pruned line and most of those in the 6″ and 12″ Burma lines were touching the adjoining bushes in every direction by the end of the season, those of the Assam and Burma 18″ prunings completely covering the ground, particularly the latter, which were densely pressed against each other. The other bushes of the 12″ original pruning had very fair spread and were in many cases in contact with their neighbours in the same line, but in no other cases were the bushes yet touching at the end of the 1922 season.

The complete absence of jungle under the 18″ pruned lines is most marked in contrast to the large quantity and rapid rate of its growth between the other lines.

For the purpose of discussing the relative advantages and disadvantages of the various systems of pruning, they may, with

the exception of the biennially pruned lines, be conveniently considered under three main headings according to the nature of the original pruning, as follows :—

(1) *Low-pruned* :—This includes all lines originally cut at 4″ or less, allowed 6″ of new wood in the second year and since then light-pruned to 4″ new wood for two years and thereafter to 2″ new wood annually.

This has, with two very small exceptions, produced the usual steady, but very gradual, increase in yield every year, and on the Assam and Burma plots has now practically drawn level with the higher-pruned types, except in the case of the collar-pruned line of Burma.

It may be termed the "slow, but sure," method, and is, on the whole, satisfactory, the leaf produced being generally of average size and the bushes healthy and a good shape.

This type of pruning, however, tends to reduce quality somewhat while the bush is being "made," and on general principles it cannot be expected that such high grade teas will be made for several years from bushes pruned in this way as from those where a greater length of wood is left originally.

The "spread" is, moreover, none too good after five years' growth, as may be seen from the second table, but the lines originally cut at 4″ and the lowest branch have, on the whole, better frames than those cut at 2″ or collar-pruned.

This may be due, especially in the case where a living branch is left, to a diminution in intensity of the stimulus to renewed growth after the original pruning, owing to its distribution amongst a larger number of potential buds.

This would result in the production of fewer and stronger shoots, and, by reason of the consequently reduced competition for light, a slower rate of growth even for those ; that is to say, a less rapid stem-elongation with a correspondingly improved radial development making for better wood, and a more horizontal initial direction, owing to the action of gravity having time to

counteract to some extent that of the sun. This would tend to produce a wider "spread."

With the exception of the collar-pruned lines, which naturally gave very low yields at first, the crop-variation in this group during the first three years is very slight; the greatest difference in the mean yields being only just over three-quarters of a maund between the 2″ and 4″ lines in 1919, which was probably due to the reduced yield on the lower pruned line of China in a bad season.

Differences become apparent, however, in the fourth year. The collar-pruned lines have by then caught up those cut to 2″, while the lowest branch and 4″ lines are beginning to show more rapid increases.

It may be observed here that the rate of yield increases more quickly after the pruning level has attained a height of approximately a foot.

This fact may be significant as an indication of the optimum height for the initial cutting of the bush.

It appears to apply generally, and is well brought out by the crop-curves, but it is more noticeable in the case of the lower original prunings, as those of 12″ or over rise steeply from the start.

(2) *Medium Pruned*:—comprising lines originally cut at 6 and 12 inches.

The system here is again that of annual light-pruning, but also includes removal of centres as soon as the bushes become sufficiently strong, the bushes originally cut at 6″ being allowed an extra 2″ of new wood in the second year.

It has unfortunately only been possible to try the initial 6″ cutting on the Burma plot, owing to shortage of lines on the others, but on this it has done very well.

It is probably the best type of pruning under trial, as it combines a fairly quick and steadily-increasing yield with better shaped frames and, except for the 18″, a larger "spread" than any other. Moreover, with careful pruning and occasional light centreing there

should be no need to cut this type of bush back for at least another four or five years.

The sides of the bushes are strong and have scarcely suffered at all from the fungus diseases which have damaged the higher pruned types, and there does not seem any reason why a further steady rise in leaf production may not confidently be expected.

Even when it is found necessary to resort to a heavier pruning, there will be no need to run the risk of introducing serious unevenness, if not of killing the bush altogether, as is so often the case with tea which has to be collar-pruned, or cut back hard, after it has been for many years in the soil.

Another distinct advantage of pruning originally at this or any greater height from the ground is, that it enables bullock-drawn or mechanical cultivators to be used for at least several years, without risk of that damage to the lower laterals which is bound to occur if these spring from the ground-level.

The 12″ pruning has produced similar bushes to those obtained by cutting at six inches, but the resulting yields, although naturally somewhat higher at first, are not quite so good on the five-year totals, owing to the harder pruning necessitated two years ago by the higher initial cutting.

The spread of the bushes has been, and still is, somewhat disappointing and, although the sides were fairly well developed from the first, they have suffered somewhat from disease, though less than those of the high-pruned lines, while the advisability of centreing earlier than the fourth year is clearly demonstrated by the very marked fall in the crop for 1921, showing that the good yield for 1920 was very largely obtained from the centres of the bush.

A notable disadvantage of this height for the initial pruning is the difficulty experienced in deciding at what level to cut such bushes, when they next require to be cut back, after they have been once medium-pruned.

The only satisfactory solution of the problem is to treat each bush individually on its merits—a system at once unpopular, in most cases on account of the labour and expense involved.

Pruning at this height has, however, also been tried extensively on two areas of young tea at Borbhetta where, combined with gradual selective centreing as low as practicable after only one or two years in the soil, it has given much more satisfactory results.

In both these cases the bushes were first pruned after they had been only one year in the soil instead of two, and were then tipped at, or broken back to, 18″ and subsequently plucked at 27″ or 30″ in the following rains, in order to make them as even as possible and to induce a rapid spread.

This has been accompanied by the removal of some light wood from the centres of such bushes as appeared to require and were strong enough to stand this treatment, which is being continued progressively each year.

One of these areas yielded nearly seven maunds of pucca tea per acre in its third season from seed, while the other has already produced very healthy and even bushes of quite a good size. On the latter area the main stems were cut below one foot, wherever there were sufficient laterals lower down to make this possible (over 80%), the average height of the cut from the ground being about 6″, but in no case above a foot.

It should perhaps be mentioned that the area which gave nearly seven maunds an acre in its third year, was very severely attacked in the following cold weather by Red Rust, which entirely killed the young side-branches on a large proportion of the bushes, as they had not yet had time to become strong enough to resist the disease. The Red Rust attack was, however, undoubtedly secondary in character, following a suspected widespread attack of die-back (*Thyradaria tarda*) and being also preceded by a bad attack of Red Spider and the complete removal of all shade for the first time since the area was planted. It may also have been due partly to deficient drainage.

(3) *High-Pruned*—The lines first pruned at 18 and 24 inches come under this heading, the subsequent plan of treatment being that of continuous top-pruning until such time as the yields begin to show a decided tendency to decrease, when the bushes are

cut back as low as may be necessary, having regard to their shape, growth and general condition, hard-centreing and cleaning-out being adopted in preference to cutting down altogether.

The 18″ pruning, which has already been discussed at some length, has, during the first five years of the experiment, given considerably the largest crops, as was only to be expected, but the leaf weights now appear to be decreasing, especially on the Burma plot, which has previously given the best crops, and it is unlikely that the high rates of yield hitherto obtained will continue much longer, although it may be noted that the Assam and China lines recovered in 1922 from the slight depression which occurred in the previous year.

These lines will therefore probably have to be cut back somewhat heavily within the next year or two, and the effects of this on bushes of such a size—the majority of the main stems are between 4 and 6 inches in diameter at the collar—may be serious and will undoubtedly result in very considerable loss of crop for several seasons.

The bushes in these lines have at present a very wide spread, but the sides have been developed from too high up the trunk. They are consequently none too strong and are readily attacked by fungi, especially Red Rust, though this has been much less in evidence on the hardier Burma Jat, which would therefore seem better suited on the whole to this type of pruning, the yields over five years from the dark and light-leaved varieties being practically equal; but the original cutting is probably too high for practical purposes in most cases.

The same remarks apply to the original 24″ pruning, though in that case with the important difference that an even larger and quicker initial yield is produced.

This splendid yield, however, only lasts for three years at most, and thus necessitates cutting back being undertaken at least three years earlier than in the case of the 18″ pruning, a great advantage to the subsequent strength and formation of the bushes, especially if collar-pruning has to be resorted to.

It is noteworthy that although no deaths occurred in the 24″ lines, the Assam bushes were very much slower to "come-away" than the bushes of the Burma plot where one low branch, however weak, was left if possible, as a "kicker," to prevent the stump from dying back. Such "kickers," in addition to preventing death, assist the bush to come away more quickly and thereby undoubtedly help to increase its yield in the following year, as is clear from a comparison of the yields from the Assam and Burma 24″ lines since they were collared in 1920.

These lines were only "skiffed" in the cold weather of 1921-22, with the result that they have begun to form very fair frames and have yielded exceptionally well again within two years of being cut down.

BIENNIAL PRUNING.

The only type of pruning in this experiment which now remains to be discussed is that applied to the second series of originally collar-pruned lines, which have subsequently been left entirely unpruned in alternate years.

So far as these trials are concerned, this experiment has proved unsatisfactory, for the comparison in this case is not a fair one, owing to two out of the three lines in question being situated on the edges of drains, which has undoubtedly adversely affected the growth of the bushes to a very marked extent.

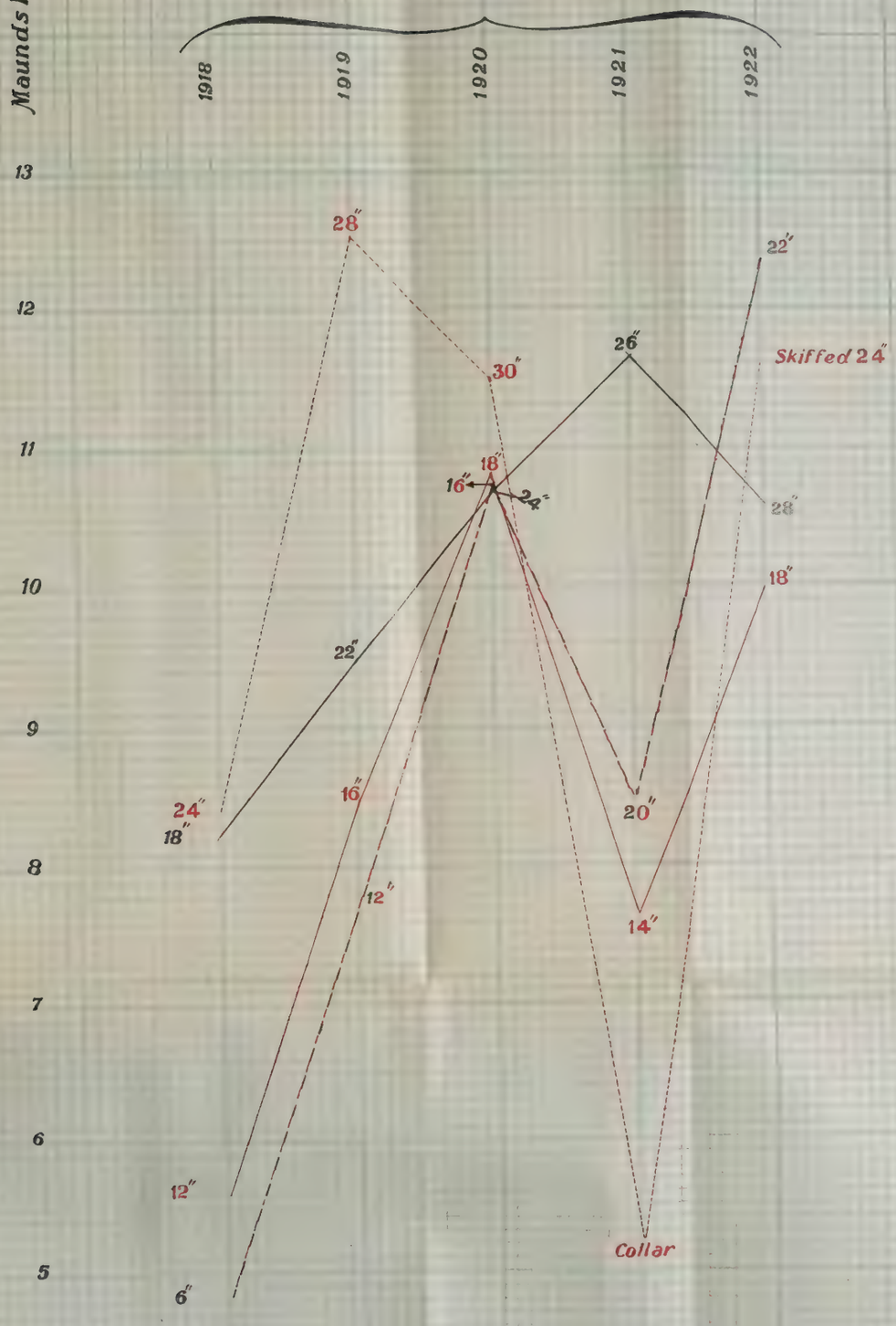
Very good yields were however obtained during 1922, notwithstanding the unfavourable season, from the "skiffed" 24″ inch lines on these plots. This has already been referred to but should also be noted in this connection, as these lines were collar-pruned as lately as autumn of 1920.

1914 Clearance :—A reasonable indication of the probable effects of this method of pruning may however be obtained by a comparison of the results on the Tocklai Clearance during the last three years, where seven large half-plots of annually-pruned tea are being tried against their complementary half-plots, which are identical in "Jat" and treatment, except for the fact that they have only been cut back biennially, since 1918 (when both series were cut to 6″), being lightly "skiffed" in alternate years.

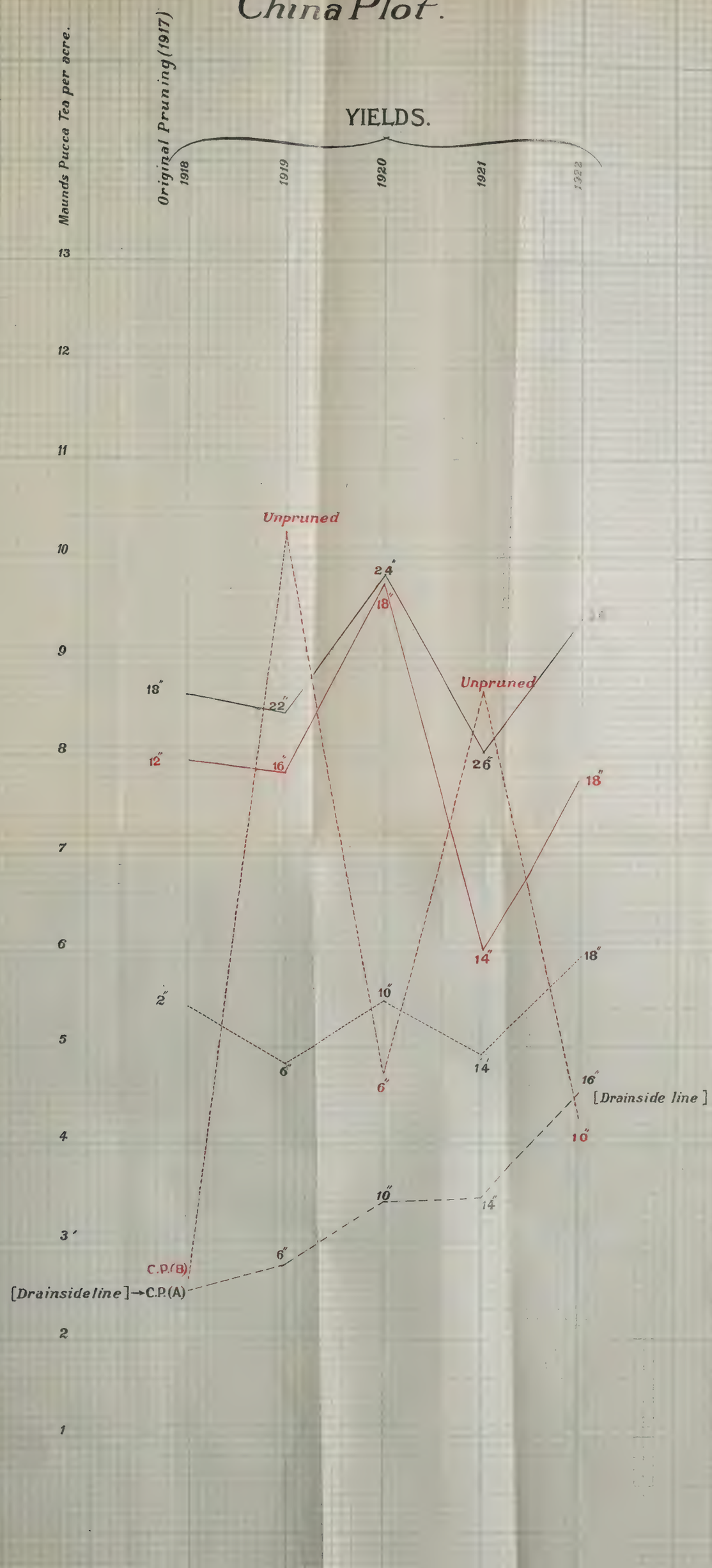
High Pruned & Medium Pruned.

YIELDS.

Maunds Pucca Teaper acre



China Plot.


YIELDS.
Original Pruning (1917)
1918
1919
1920
1921
1922
Maunds Pucca Tea per acre.
13
12
11
10
9
8
7
6
5
4
3
2
1
Unpruned
24"
18"
18"
22"
12"
16"
Unpruned
26"
18"
14"
18"
2"
10"
6"
6"
14"
16"
[Drainside line]
10"
10"
14"
6"
C.P.(B)
[Drainside line] → C.P.(A)

The following are the mean yields from both types of pruning for each year up to date, giving the relative heights of the bushes after pruning in the previous cold weather.

TABLE III.

Pruning and Mean Yields, Tocklai Clearance, 1916-1922.

PRUNING.			YIELDS. (Maunds, Pucca Tea per Acre)		
1916	Collar (whole area) ...				
1918	Unpruned " " ...		1917, 1918, 1919	13·92 (Whole Area)	
1919	6″ " " ...				
Half-plots.	Annual	Biennial	Half-plots	Annual	Biennial
1919	10″	Skiffed			
1920	14″	10″	1920	4·77	11·63
1921	16″	Skiffed	1921	9·03	8·29
			1922	12·30	11·15
		TOTAL	1917-1922	40·02	44·99

These figures form a good illustration of the aphorism that "Unpruned tea is a gamble with the weather."

Climate undoubtedly exercises a controlling influence on the success or failure of unpruned tea, and the probability of early rainfall, taken in conjunction with the type of soil, are the main factors to be considered in deciding whether to risk the "gamble."

The season 1920 was a particularly good one for unpruned tea in this district, but those of the subsequent years have been more favourable to annual pruning, 1922 being a particularly bad year for "unpruned."

The biennial pruning, with an initial advantage in height of about 16 or 17 inches, consequently shows to great advantage in 1920, the fourth year of plucking this area.

It is an established fact, however, that it is a great advantage, particularly in respect of increased crop, to leave tea unpruned, if climatically possible, in the pruning seasons immediately following those in which collar-pruning and the first subsequent heavy-cutting (6 to 9 inches) are done :—for young tea, normally its 2nd and 4th years in the soil. This point need not therefore be dealt with here at greater length.

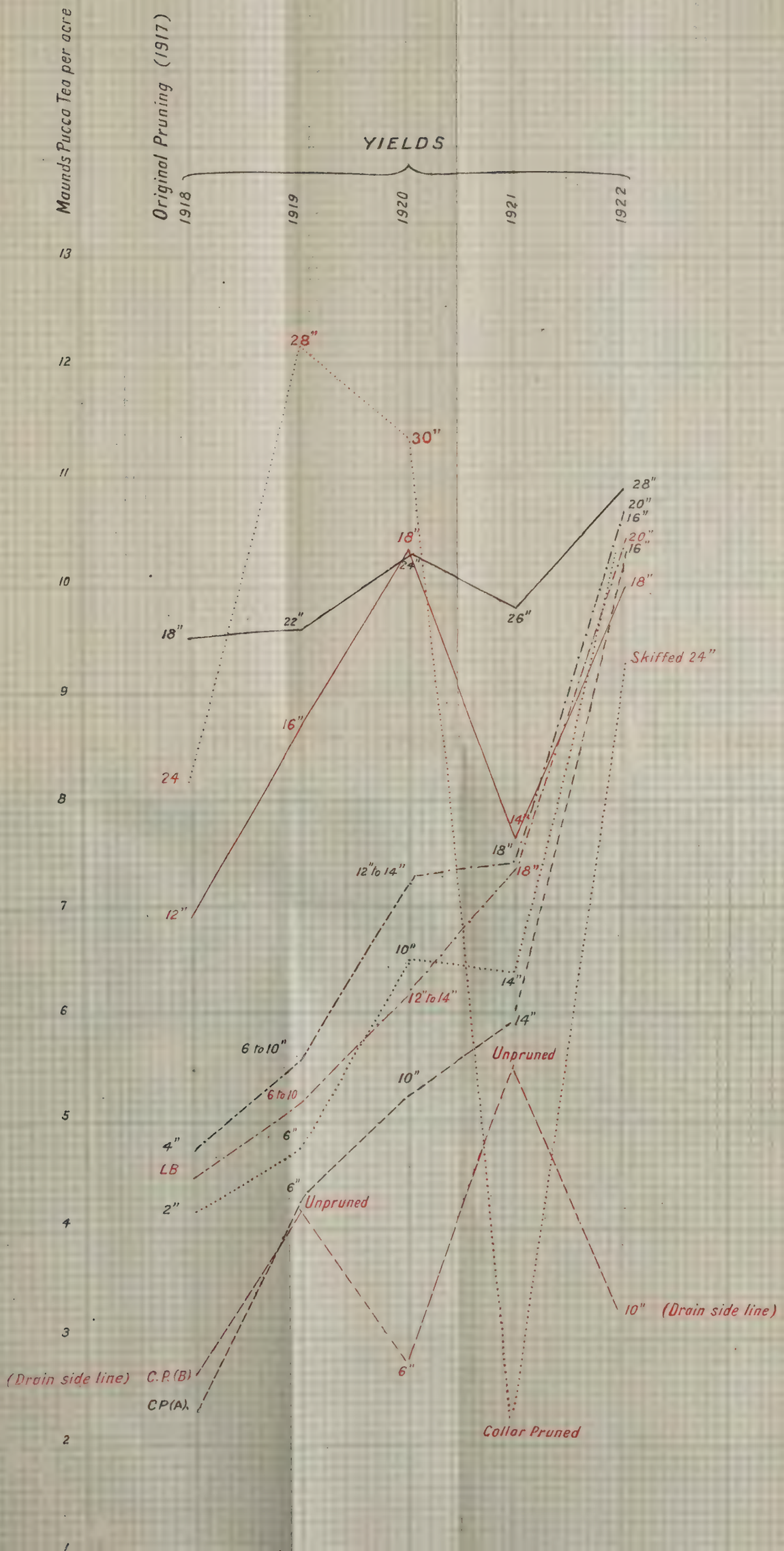
Whether pruning only in alternate years *continues* to be beneficial after this, is however open to considerable doubt, as is evidenced by a comparison of the crop figures for 1920 and 1922 in table III, where it is particularly noteworthy that the biennial yield is actually *half a maund lower for 1922 than it was in 1920 when the bushes were 2 years younger*, and more than a maund lower than the 1922 annual pruning yield, though the latter started the season at a disadvantage in height of about 14 inches.

A disadvantage of biennial pruning is that it results in the production of very small leaf, which is inclined to be leathery and to contain a high percentage of rather hard stalk in the unpruned (or "skiffed") year, and thereby not only tends to reduce the value of the tea, but greatly increases the cost of plucking.

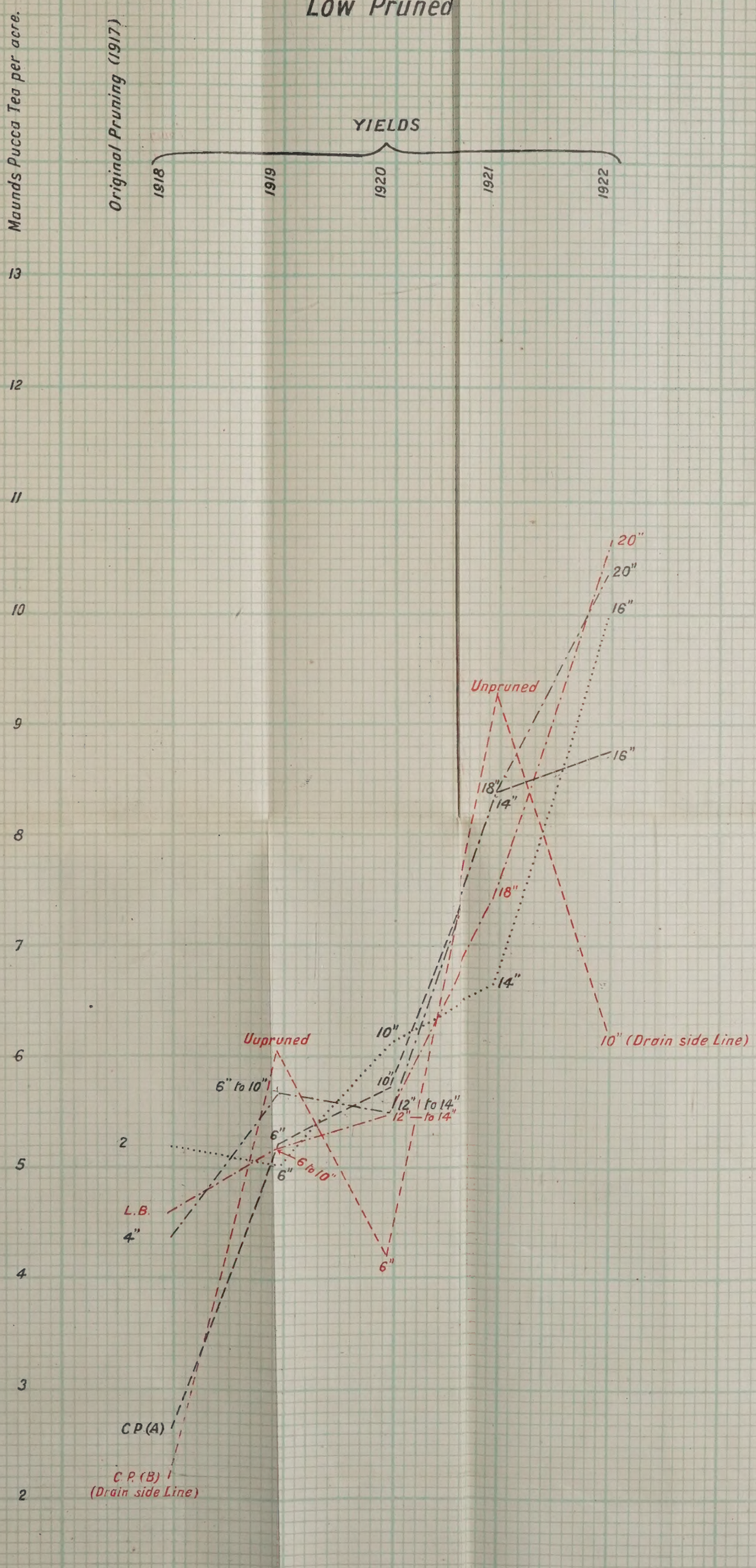
The tannin content of leaf is however higher, and liquors generally are rather better than from pruned tea.

H. H. W.

ASSAM PLOT.


Maunds Pucca Tea per acre
Original Pruning (1917)
YIELDS
1918
1919
1920
1921
1922
13
12
11
10
9
8
7
6
5
4
3
2
28"
30"
18"
22"
24"
26"
28"
20"
16"
18"
24
16"
12"
14"
18"
12"to 14"
18"
10"
14"
12"to 14"
14"
6 to 10"
Unpruned
6 to 10
10"
4"
6"
LB
2"
6"
Unpruned
Skiffed 24"
10" (Drain side line)
6"
(Drain side line)
C.P.(B)
CP(A).
Collar Pruned

BURMA PLOT.
Low Pruned



A NEW BOOK ON TEA DISEASES.

Messrs. Macmillan and Company have recently published a book entitled "The Diseases of the Tea Bush," written by Mr. T. Petch, B.A., B.SC., the well-known Mycologist to the Government of Ceylon. Mr. Petch was well known as an authority on fungus disease before the Indian Tea Association's Mycological Department came into being. His experience is by no means confined to the fungi associated with disease in tea. The scope of the book is described in a few words in the Publishers' note on the cover :— "The book is intended to enable the planter to recognise the diseases of the tea-bush which have up to the present been recorded, and to take steps to control them when they appear or to lessen the probability of their occurrence. It is of exceptional value, owing to the qualifications of the author, and the fact that very few works have as yet been written upon the subject."

Some time ago a planter, in criticising the work of the Department, said that planters did not want to know the life-histories of the various diseases. They only wanted to know their death histories. All he personally wanted from the Mycological Department was definite instructions as to the treatment of any disease of his tea bushes. Both the life-histories and the death-histories are so simply described, and so amply illustrated, that even the above-mentioned critic would find the book of considerable use.

Although some sixty diseases are described, the book is not too technical for the ordinary layman. The illustrations, both in colour and black and white, will be found very helpful. The chapters on stem and root diseases are also specially useful.

It is interesting to note that in Ceylon the brown fungus, long known as *Hymenochaete noxia*, has been found to be caused by a species of *Fomes*. Until recently, no mature fructifications of this fungus had been found in North-east India. A month or two ago, however, some were produced on a stump which

had been killed by the brown root rot a very long time before. These fruit bodies showed the fungus to be a species of *Fomes*. The spores were grown in pure culture and inoculations are being carried out. It is impossible to say definitely that the fungus is identical with that commonly known as *Hymenochaete noxia* until the disease has been produced artificially from the spores.

The price of the boo is Rs. 16-8 net.

A. C. T.